

# LIGHT UNFLAVORED MESONS

## ( $S = C = B = 0$ )

For  $I = 1$  ( $\pi, b, \rho, a$ ):  $u\bar{d}, (u\bar{u} - d\bar{d})/\sqrt{2}, d\bar{u}$ ;  
 for  $I = 0$  ( $\eta, \eta', h, h', \omega, \phi, f, f'$ ):  $c_1(u\bar{u} + d\bar{d}) + c_2(s\bar{s})$

$\pi^\pm$

$$I^G(J^P) = 1^-(0^-)$$

Mass  $m = 139.57018 \pm 0.00035$  MeV ( $S = 1.2$ )  
 Mean life  $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$  s ( $S = 1.2$ )  
 $c\tau = 7.8045$  m

$\pi^\pm \rightarrow \ell^\pm \nu \gamma$  form factors <sup>[a]</sup>

$$F_V = 0.0254 \pm 0.0017$$

$$F_A = 0.0119 \pm 0.0001$$

$$F_V$$
 slope parameter  $a = 0.10 \pm 0.06$

$$R = 0.059^{+0.009}_{-0.008}$$

$\pi^-$  modes are charge conjugates of the modes below.

For decay limits to particles which are not established, see the section on Searches for Axions and Other Very Light Bosons.

$\pi^\pm$ DECAY MODES		Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\mu^+ \nu_\mu$	[b]	(99.98770 $\pm 0.00004$ ) %	30	
$\mu^+ \nu_\mu \gamma$	[c]	( 2.00 $\pm 0.25$ ) $\times 10^{-4}$	30	
$e^+ \nu_e$	[b]	( 1.230 $\pm 0.004$ ) $\times 10^{-4}$	70	
$e^+ \nu_e \gamma$	[c]	( 7.39 $\pm 0.05$ ) $\times 10^{-7}$	70	
$e^+ \nu_e \pi^0$		( 1.036 $\pm 0.006$ ) $\times 10^{-8}$	4	
$e^+ \nu_e e^+ e^-$		( 3.2 $\pm 0.5$ ) $\times 10^{-9}$	70	
$e^+ \nu_e \nu \bar{\nu}$	< 5	$\times 10^{-6}$ 90%	70	
<b>Lepton Family number (<math>LF</math>) or Lepton number (<math>L</math>) violating modes</b>				
$\mu^+ \bar{\nu}_e$	$L$	[d] < 1.5	$\times 10^{-3}$ 90%	30
$\mu^+ \nu_e$	$LF$	[d] < 8.0	$\times 10^{-3}$ 90%	30
$\mu^- e^+ e^+ \nu$	$LF$	< 1.6	$\times 10^{-6}$ 90%	30

$\pi^0$

$$I^G(J^P C) = 1^-(0^-+)$$

Mass  $m = 134.9766 \pm 0.0006$  MeV ( $S = 1.1$ )  
 $m_{\pi^\pm} - m_{\pi^0} = 4.5936 \pm 0.0005$  MeV  
 Mean life  $\tau = (8.52 \pm 0.18) \times 10^{-17}$  s ( $S = 1.2$ )  
 $c\tau = 25.5$  nm

NODE=MXXX005

NODE=S008

NODE=S008M;DTYPE=M

NODE=S008T;DTYPE=T

NODE=S008CTA;DTYPE=C;OUR EVAL

CLUMP=F

NODE=S008FV;DTYPE=f;CLUMP=F

NODE=S008FA;DTYPE=f;CLUMP=F

NODE=S008FSV;DTYPE=f;CLUMP=F

NODE=S008FR;DTYPE=f;CLUMP=F

NODE=S008230;NODE=S008

DESIG=1;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$   
 DESIG=3  
 DESIG=2  
 DESIG=5  
 DESIG=4  
 DESIG=6  
 DESIG=10

NODE=S008;CLUMP=A  
 DESIG=7  
 DESIG=8  
 DESIG=9

NODE=S009

NODE=S009M;DTYPE=M

NODE=S009D;DTYPE=D

NODE=S009T;DTYPE=T

NODE=S009CTA;DTYPE=C;OUR EVAL

For decay limits to particles which are not established, see the appropriate Search sections ( $A^0$  (axion) and Other Light Boson ( $X^0$ ) Searches, etc.).

NODE=S009215;NODE=S009

<b><math>\pi^0</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)	
$2\gamma$	$(98.823 \pm 0.034) \%$	S=1.5	67	
$e^+ e^- \gamma$	$(1.174 \pm 0.035) \%$	S=1.5	67	DESIG=1
$\gamma$ positronium	$(1.82 \pm 0.29) \times 10^{-9}$		67	DESIG=2
$e^+ e^+ e^- e^-$	$(3.34 \pm 0.16) \times 10^{-5}$		67	DESIG=20
$e^+ e^-$	$(6.46 \pm 0.33) \times 10^{-8}$		67	DESIG=3
$4\gamma$	$< 2 \times 10^{-8}$ CL=90%		67	DESIG=6
$\nu\bar{\nu}$	[e] $< 2.7 \times 10^{-7}$ CL=90%		67	DESIG=5
$\nu_e \bar{\nu}_e$	$< 1.7 \times 10^{-6}$ CL=90%		67	DESIG=7
$\nu_\mu \bar{\nu}_\mu$	$< 1.6 \times 10^{-6}$ CL=90%		67	DESIG=11
$\nu_\tau \bar{\nu}_\tau$	$< 2.1 \times 10^{-6}$ CL=90%		67	DESIG=12
$\gamma\nu\bar{\nu}$	$< 6 \times 10^{-4}$ CL=90%		67	DESIG=13
				DESIG=15
<b>Charge conjugation (C) or Lepton Family number (LF) violating modes</b>				
$3\gamma$	C $< 3.1 \times 10^{-8}$ CL=90%		67	NODE=S009;CLUMP=A
$\mu^+ e^-$	LF $< 3.8 \times 10^{-10}$ CL=90%		26	DESIG=4
$\mu^- e^+$	LF $< 3.4 \times 10^{-9}$ CL=90%		26	DESIG=14
$\mu^+ e^- + \mu^- e^+$	LF $< 3.6 \times 10^{-10}$ CL=90%		26	DESIG=22
				DESIG=8



$$\mathcal{I}^G(J^{PC}) = 0^+(0 - +)$$

Mass  $m = 547.862 \pm 0.018$  MeV

Full width  $\Gamma = 1.31 \pm 0.05$  keV

NODE=S014

NODE=S014M;DTYPE=M

NODE=S014W;DTYPE=G

CLUMP=D

NODE=S014A1;DTYPE=d;CLUMP=D

NODE=S014AS;DTYPE=d;CLUMP=D

NODE=S014AQ;DTYPE=d;CLUMP=D

NODE=S014A2;DTYPE=d;CLUMP=D

NODE=S014BET;DTYPE=d;CLUMP=D

CLUMP=F

NODE=S014AET;DTYPE=d;CLUMP=F

CLUMP=E

NODE=S014A0;DTYPE=d;CLUMP=E

### C-nonconserving decay parameters

$\pi^+ \pi^- \pi^0$  left-right asymmetry  $= (0.09^{+0.11}_{-0.12}) \times 10^{-2}$

$\pi^+ \pi^- \pi^0$  sextant asymmetry  $= (0.12^{+0.10}_{-0.11}) \times 10^{-2}$

$\pi^+ \pi^- \pi^0$  quadrant asymmetry  $= (-0.09 \pm 0.09) \times 10^{-2}$

$\pi^+ \pi^- \gamma$  left-right asymmetry  $= (0.9 \pm 0.4) \times 10^{-2}$

$\pi^+ \pi^- \gamma$   $\beta$  (D-wave)  $= -0.02 \pm 0.07$  (S = 1.3)

### CP-nonconserving decay parameters

$\pi^+ \pi^- e^+ e^-$  decay-plane asymmetry  $A_\phi = (-0.6 \pm 3.1) \times 10^{-2}$

### Dalitz plot parameter

$\pi^0 \pi^0 \pi^0$   $\alpha = -0.0315 \pm 0.0015$

$\eta$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)		
<b>Neutral modes</b>					
neutral modes	$(72.12 \pm 0.34) \%$	S=1.2	—	NODE=S014215;NODE=S014;CLUMP=N DESIG=101	
$2\gamma$	$(39.41 \pm 0.20) \%$	S=1.1	274	DESIG=1	
$3\pi^0$	$(32.68 \pm 0.23) \%$	S=1.1	179	DESIG=2	
$\pi^0 2\gamma$	$(2.7 \pm 0.5) \times 10^{-4}$	S=1.1	257	DESIG=7	
$2\pi^0 2\gamma$	$< 1.2 \times 10^{-3}$	CL=90%	238	DESIG=105	
$4\gamma$	$< 2.8 \times 10^{-4}$	CL=90%	274	DESIG=108	
invisible	$< 1.0 \times 10^{-4}$	CL=90%	—	DESIG=107	
<b>Charged modes</b>					
charged modes	$(28.10 \pm 0.34) \%$	S=1.2	—	NODE=S014;CLUMP=C DESIG=102;OUR EVAL; $\rightarrow$ UNCHECKED $\leftarrow$	
$\pi^+ \pi^- \pi^0$	$(22.92 \pm 0.28) \%$	S=1.2	174	DESIG=3	
$\pi^+ \pi^- \gamma$	$(4.22 \pm 0.08) \%$	S=1.1	236	DESIG=4	
$e^+ e^- \gamma$	$(6.9 \pm 0.4) \times 10^{-3}$	S=1.3	274	DESIG=8	
$\mu^+ \mu^- \gamma$	$(3.1 \pm 0.4) \times 10^{-4}$	—	253	DESIG=13	
$e^+ e^-$	$< 5.6 \times 10^{-6}$	CL=90%	274	DESIG=16	
$\mu^+ \mu^-$	$(5.8 \pm 0.8) \times 10^{-6}$	—	253	DESIG=12	
$2e^+ 2e^-$	$(2.40 \pm 0.22) \times 10^{-5}$	—	274	DESIG=25	
$\pi^+ \pi^- e^+ e^- (\gamma)$	$(2.68 \pm 0.11) \times 10^{-4}$	—	235	DESIG=6	
$e^+ e^- \mu^+ \mu^-$	$< 1.6 \times 10^{-4}$	CL=90%	253	DESIG=109	
$2\mu^+ 2\mu^-$	$< 3.6 \times 10^{-4}$	CL=90%	161	DESIG=110	
$\mu^+ \mu^- \pi^+ \pi^-$	$< 3.6 \times 10^{-4}$	CL=90%	113	DESIG=111	
$\pi^+ e^- \bar{\nu}_e + \text{c.c.}$	$< 1.7 \times 10^{-4}$	CL=90%	256	DESIG=112	
$\pi^+ \pi^- 2\gamma$	$< 2.1 \times 10^{-3}$	—	236	DESIG=11	
$\pi^+ \pi^- \pi^0 \gamma$	$< 5 \times 10^{-4}$	CL=90%	174	DESIG=10	
$\pi^0 \mu^+ \mu^- \gamma$	$< 3 \times 10^{-6}$	CL=90%	210	DESIG=17	
<b>Charge conjugation (C), Parity (P), Charge conjugation <math>\times</math> Parity (CP), or Lepton Family number (LF) violating modes</b>					
$\pi^0 \gamma$	C	$< 9 \times 10^{-5}$	CL=90%	257	DESIG=104
$\pi^+ \pi^-$	P,CP	$< 1.3 \times 10^{-5}$	CL=90%	236	DESIG=15
$2\pi^0$	P,CP	$< 3.5 \times 10^{-4}$	CL=90%	238	DESIG=21
$2\pi^0 \gamma$	C	$< 5 \times 10^{-4}$	CL=90%	238	DESIG=103
$3\pi^0 \gamma$	C	$< 6 \times 10^{-5}$	CL=90%	179	DESIG=106
$3\gamma$	C	$< 1.6 \times 10^{-5}$	CL=90%	274	DESIG=18
$4\pi^0$	P,CP	$< 6.9 \times 10^{-7}$	CL=90%	40	DESIG=24
$\pi^0 e^+ e^-$	C	[f] $< 4 \times 10^{-5}$	CL=90%	257	DESIG=5
$\pi^0 \mu^+ \mu^-$	C	[f] $< 5 \times 10^{-6}$	CL=90%	210	DESIG=14
$\mu^+ e^- + \mu^- e^+$	LF	$< 6 \times 10^{-6}$	CL=90%	264	DESIG=20

$f_0(500)$  or  $\sigma^{[g]}$   
was  $f_0(600)$

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = (400\text{--}550)$  MeV  
Full width  $\Gamma = (400\text{--}700)$  MeV

NODE=M014

NODE=M014M;DTYPE=M;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$   
NODE=M014W;DTYPE=G;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$

$f_0(500)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi \pi$	dominant	—
$\gamma \gamma$	seen	—

$\rho(770)^{[h]}$

$$I^G(J^{PC}) = 1^+(1^{--})$$

Mass  $m = 775.26 \pm 0.25$  MeV  
Full width  $\Gamma = 149.1 \pm 0.8$  MeV  
 $\Gamma_{ee} = 7.04 \pm 0.06$  keV

NODE=M009

NODE=M009M0;DTYPE=M  
NODE=M009W5;DTYPE=G  
NODE=M009W4;DTYPE=E

<b><math>\rho(770)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )		Scale factor/ Confidence level	$p$ (MeV/c)	
$\pi\pi$	$\sim 100$	%		363	NODE=M009225;DESIG=1;OUR EVAL; → UNCHECKED ←
<b><math>\rho(770)^{\pm}</math> decays</b>					
$\pi^\pm\gamma$	$(4.5 \pm 0.5) \times 10^{-4}$		S=2.2	375	NODE=M009;CLUMP=A
$\pi^\pm\eta$	$< 6 \times 10^{-3}$		CL=84%	152	DESIG=3
$\pi^\pm\pi^+\pi^-\pi^0$	$< 2.0 \times 10^{-3}$		CL=84%	254	DESIG=5
<b><math>\rho(770)^0</math> decays</b>					
$\pi^+\pi^-\gamma$	$(9.9 \pm 1.6) \times 10^{-3}$			362	DESIG=21
$\pi^0\gamma$	$(6.0 \pm 0.8) \times 10^{-4}$			376	NODE=M009;CLUMP=B
$\eta\gamma$	$(3.00 \pm 0.20) \times 10^{-4}$			194	DESIG=40
$\pi^0\pi^0\gamma$	$(4.5 \pm 0.8) \times 10^{-5}$			363	DESIG=8
$\mu^+\mu^-$	$[i] (4.55 \pm 0.28) \times 10^{-5}$			373	DESIG=80
$e^+e^-$	$[i] (4.72 \pm 0.05) \times 10^{-5}$			388	DESIG=6
$\pi^+\pi^-\pi^0$	$(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$			323	DESIG=4
$\pi^+\pi^-\pi^+\pi^-$	$(1.8 \pm 0.9) \times 10^{-5}$			251	DESIG=7;OUR EVAL;→ UNCHECKED ←
$\pi^+\pi^-\pi^0\pi^0$	$(1.6 \pm 0.8) \times 10^{-5}$			257	DESIG=22
$\pi^0e^+e^-$	$< 1.2 \times 10^{-5}$	CL=90%		376	DESIG=30
					DESIG=9

 **$\omega(782)$** 

$$\mathcal{I}^G(J^PC) = 0^-(1^{--})$$

Mass  $m = 782.65 \pm 0.12$  MeV (S = 1.9)Full width  $\Gamma = 8.49 \pm 0.08$  MeV $\Gamma_{ee} = 0.60 \pm 0.02$  keV

<b><math>\omega(782)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )		Scale factor/ Confidence level	$p$ (MeV/c)	
$\pi^+\pi^-\pi^0$	$(89.2 \pm 0.7) \%$			327	NODE=M001215;DESIG=1
$\pi^0\gamma$	$(8.28 \pm 0.28) \%$		S=2.1	380	DESIG=3
$\pi^+\pi^-$	$(1.53^{+0.11}_{-0.13}) \%$		S=1.2	366	DESIG=2
nevtrals (excluding $\pi^0\gamma$ )					
	$(8^{+8}_{-5}) \times 10^{-3}$		S=1.1	—	DESIG=13
$\eta\gamma$	$(4.6 \pm 0.4) \times 10^{-4}$		S=1.1	200	DESIG=6
$\pi^0e^+e^-$	$(7.7 \pm 0.6) \times 10^{-4}$			380	DESIG=14
$\pi^0\mu^+\mu^-$	$(1.3 \pm 0.4) \times 10^{-4}$		S=2.1	349	DESIG=11
$e^+e^-$	$(7.28 \pm 0.14) \times 10^{-5}$		S=1.3	391	DESIG=7
$\pi^+\pi^-\pi^0\pi^0$	$< 2 \times 10^{-4}$	CL=90%		262	DESIG=12
$\pi^+\pi^-\gamma$	$< 3.6 \times 10^{-3}$	CL=95%		366	DESIG=4
$\pi^+\pi^-\pi^+\pi^-$	$< 1 \times 10^{-3}$	CL=90%		256	DESIG=15
$\pi^0\pi^0\gamma$	$(6.6 \pm 1.1) \times 10^{-5}$			367	DESIG=5
$\eta\pi^0\gamma$	$< 3.3 \times 10^{-5}$	CL=90%		162	DESIG=17
$\mu^+\mu^-$	$(9.0 \pm 3.1) \times 10^{-5}$			377	DESIG=8
$3\gamma$	$< 1.9 \times 10^{-4}$	CL=95%		391	DESIG=10
<b>Charge conjugation (C) violating modes</b>					
$\eta\pi^0$	$C < 2.1 \times 10^{-4}$	CL=90%		162	NODE=M001;CLUMP=A
$2\pi^0$	$C < 2.1 \times 10^{-4}$	CL=90%		367	DESIG=9
$3\pi^0$	$C < 2.3 \times 10^{-4}$	CL=90%		330	DESIG=193
					DESIG=16

 **$\eta'(958)$** 

$$\mathcal{I}^G(J^PC) = 0^+(0^{--})$$

Mass  $m = 957.78 \pm 0.06$  MeVFull width  $\Gamma = 0.198 \pm 0.009$  MeV

NODE=M002

NODE=M002M;DTYPE=M

NODE=M002W;DTYPE=G

<b><math>\eta'(958)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)	
$\pi^+ \pi^- \eta$	(42.9 $\pm$ 0.7) %		232	NODE=M002215;DESIG=1
$\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$ )	(29.1 $\pm$ 0.5) %		165	DESIG=9
$\pi^0 \pi^0 \eta$	(22.2 $\pm$ 0.8) %		239	DESIG=2
$\omega \gamma$	( 2.75 $\pm$ 0.23) %		159	DESIG=7
$\gamma \gamma$	( 2.20 $\pm$ 0.08) %		479	DESIG=6
$3\pi^0$	( 2.14 $\pm$ 0.20) $\times 10^{-3}$		430	DESIG=8
$\mu^+ \mu^- \gamma$	( 1.08 $\pm$ 0.27) $\times 10^{-4}$		467	DESIG=20
$\pi^+ \pi^- \mu^+ \mu^-$	< 2.2 $\times 10^{-4}$	90%	401	DESIG=201
$\pi^+ \pi^- \pi^0$	( 3.8 $\pm$ 0.4) $\times 10^{-3}$		428	DESIG=121
$\pi^0 \rho^0$	< 4 %	90%	111	DESIG=18
$2(\pi^+ \pi^-)$	< 2.4 $\times 10^{-4}$	90%	372	DESIG=131
$\pi^+ \pi^- 2\pi^0$	< 2.5 $\times 10^{-3}$	90%	376	DESIG=202
$2(\pi^+ \pi^-)$ neutrals	< 1 %	95%	—	DESIG=132
$2(\pi^+ \pi^-)\pi^0$	< 1.9 $\times 10^{-3}$	90%	298	DESIG=141
$2(\pi^+ \pi^-)2\pi^0$	< 1 %	95%	197	DESIG=15
$3(\pi^+ \pi^-)$	< 5 $\times 10^{-4}$	90%	189	DESIG=203
$\pi^+ \pi^- e^+ e^-$	( 2.4 $\pm$ 1.3) $\times 10^{-3}$		458	DESIG=10
$\pi^+ e^- \nu_e + \text{c.c.}$	< 2.1 $\times 10^{-4}$	90%	469	DESIG=204
$\gamma e^+ e^-$	< 9 $\times 10^{-4}$	90%	479	DESIG=28
$\pi^0 \gamma \gamma$	< 8 $\times 10^{-4}$	90%	469	DESIG=24
$4\pi^0$	< 5 $\times 10^{-4}$	90%	380	DESIG=26
$e^+ e^-$	< 2.1 $\times 10^{-7}$	90%	479	DESIG=150
invisible	< 5 $\times 10^{-4}$	90%	—	DESIG=200

**Charge conjugation (C), Parity (P),  
Lepton family number (LF) violating modes**

NODE=M002;CLUMP=B

$\pi^+ \pi^-$	$P, CP$	< 6 $\times 10^{-5}$	90%	458	DESIG=111
$\pi^0 \pi^0$	$P, CP$	< 4 $\times 10^{-4}$	90%	459	DESIG=25
$\pi^0 e^+ e^-$	$C$	[f] < 1.4 $\times 10^{-3}$	90%	469	DESIG=16
$\eta e^+ e^-$	$C$	[f] < 2.4 $\times 10^{-3}$	90%	322	DESIG=17
$3\gamma$	$C$	< 1.0 $\times 10^{-4}$	90%	479	DESIG=23
$\mu^+ \mu^- \pi^0$	$C$	[f] < 6.0 $\times 10^{-5}$	90%	445	DESIG=22
$\mu^+ \mu^- \eta$	$C$	[f] < 1.5 $\times 10^{-5}$	90%	273	DESIG=21
$e \mu$	$LF$	< 4.7 $\times 10^{-4}$	90%	473	DESIG=27

 **$f_0(980)$  [i]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 990 \pm 20$  MeVFull width  $\Gamma = 40$  to 100 MeV

NODE=M003

NODE=M003M1;DTYPE=M;OUR EST;  
 $\xrightarrow{\text{→}}$  UNCHECKED  $\xleftarrow{\text{←}}$   
 NODE=M003W1;DTYPE=G;OUR EST;  
 $\xrightarrow{\text{→}}$  UNCHECKED  $\xleftarrow{\text{←}}$ 

<b><math>f_0(980)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)	
$\pi \pi$	dominant	476	
$K \bar{K}$	seen	36	
$\gamma \gamma$	seen	495	

 **$a_0(980)$  [i]**

$$I^G(J^{PC}) = 1^-(0^{++})$$

Mass  $m = 980 \pm 20$  MeVFull width  $\Gamma = 50$  to 100 MeV

NODE=M036

NODE=M036MX;DTYPE=M;OUR EST;  
 $\xrightarrow{\text{→}}$  UNCHECKED  $\xleftarrow{\text{←}}$   
 NODE=M036W1;DTYPE=G;OUR EST;  
 $\xrightarrow{\text{→}}$  UNCHECKED  $\xleftarrow{\text{←}}$

**$a_0(980)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\eta\pi$	dominant	319
$K\bar{K}$	seen	†
$\gamma\gamma$	seen	490

 **$\phi(1020)$** 

$I^G(J^{PC}) = 0^-(1^{--})$

Mass  $m = 1019.455 \pm 0.020$  MeV (S = 1.1)  
 Full width  $\Gamma = 4.26 \pm 0.04$  MeV (S = 1.4)

 **$\phi(1020)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ )Scale factor/  
Confidence level $p$  (MeV/c)

$K^+K^-$	(48.9 $\pm$ 0.5) %	S=1.1	127
$K_L^0 K_S^0$	(34.2 $\pm$ 0.4) %	S=1.1	110
$\rho\pi + \pi^+\pi^-\pi^0$	(15.32 $\pm$ 0.32) %	S=1.1	—
$\eta\gamma$	(1.309 $\pm$ 0.024) %	S=1.2	363
$\pi^0\gamma$	(1.27 $\pm$ 0.06) $\times 10^{-3}$		501
$\ell^+\ell^-$	—		510
$e^+e^-$	(2.954 $\pm$ 0.030) $\times 10^{-4}$	S=1.1	510
$\mu^+\mu^-$	(2.87 $\pm$ 0.19) $\times 10^{-4}$		499
$\eta e^+e^-$	(1.15 $\pm$ 0.10) $\times 10^{-4}$		363
$\pi^+\pi^-$	(7.4 $\pm$ 1.3) $\times 10^{-5}$		490
$\omega\pi^0$	(4.7 $\pm$ 0.5) $\times 10^{-5}$		171
$\omega\gamma$	< 5 %	CL=84%	209
$\rho\gamma$	< 1.2 $\times 10^{-5}$	CL=90%	215
$\pi^+\pi^-\gamma$	(4.1 $\pm$ 1.3) $\times 10^{-5}$		490
$f_0(980)\gamma$	(3.22 $\pm$ 0.19) $\times 10^{-4}$	S=1.1	29
$\pi^0\pi^0\gamma$	(1.13 $\pm$ 0.06) $\times 10^{-4}$		492
$\pi^+\pi^-\pi^+\pi^-$	(4.0 $\pm$ 2.8) $\times 10^{-6}$		410
$\pi^+\pi^+\pi^-\pi^-\pi^0$	< 4.6 $\times 10^{-6}$	CL=90%	342
$\pi^0e^+e^-$	(1.12 $\pm$ 0.28) $\times 10^{-5}$		501
$\pi^0\eta\gamma$	(7.27 $\pm$ 0.30) $\times 10^{-5}$	S=1.5	346
$a_0(980)\gamma$	(7.6 $\pm$ 0.6) $\times 10^{-5}$		39
$K^0\bar{K}^0\gamma$	< 1.9 $\times 10^{-8}$	CL=90%	110
$\eta'(958)\gamma$	(6.25 $\pm$ 0.21) $\times 10^{-5}$		60
$\eta\pi^0\pi^0\gamma$	< 2 $\times 10^{-5}$	CL=90%	293
$\mu^+\mu^-\gamma$	(1.4 $\pm$ 0.5) $\times 10^{-5}$		499
$\rho\gamma\gamma$	< 1.2 $\times 10^{-4}$	CL=90%	215
$\eta\pi^+\pi^-$	< 1.8 $\times 10^{-5}$	CL=90%	288
$\eta\mu^+\mu^-$	< 9.4 $\times 10^{-6}$	CL=90%	321

**Lepton Family number (LF) violating modes** $e^\pm\mu^\mp$  LF < 2  $\times 10^{-6}$  CL=90% 504

NODE=M036215;DESIG=1;OUR EST;  
 → UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←

NODE=M004

NODE=M004M;DTYPE=M  
 NODE=M004W;DTYPE=G

NODE=M004215;DESIG=1  
 DESIG=2  
 DESIG=24  
 DESIG=4  
 DESIG=7  
 DESIG=256;OUR EVAL;→ UNCHECKED ←  
 DESIG=5  
 DESIG=6  
 DESIG=17  
 DESIG=8  
 DESIG=25  
 DESIG=10  
 DESIG=12  
 DESIG=9  
 DESIG=20  
 DESIG=19  
 DESIG=15  
 DESIG=14  
 DESIG=21  
 DESIG=22  
 DESIG=23  
 DESIG=257  
 DESIG=194  
 DESIG=195  
 DESIG=196  
 DESIG=250  
 DESIG=255  
 DESIG=26

NODE=M004;CLUMP=A  
 DESIG=258

 **$h_1(1170)$** 

$I^G(J^{PC}) = 0^-(1^{+-})$

Mass  $m = 1170 \pm 20$  MeV  
 Full width  $\Gamma = 360 \pm 40$  MeV

 **$h_1(1170)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\rho\pi$	seen	308
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NODE=M030

NODE=M030M;DTYPE=M;OUR EST;  
 → UNCHECKED ←  
 NODE=M030W;DTYPE=G;OUR EST;  
 → UNCHECKED ←

NODE=M030215;DESIG=1;OUR EST;  
 → UNCHECKED ←

NODE=M011

NODE=M011M;DTYPE=M  
 NODE=M011W;DTYPE=G

 **$b_1(1235)$** 

$I^G(J^{PC}) = 1^+(1^{+-})$

Mass  $m = 1229.5 \pm 3.2$  MeV (S = 1.6)  
 Full width  $\Gamma = 142 \pm 9$  MeV (S = 1.2)

<b>b<sub>1</sub>(1235) DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\omega\pi$	dominant [D/S amplitude ratio = $0.277 \pm 0.027$ ]		348
$\pi^\pm\gamma$	$(1.6 \pm 0.4) \times 10^{-3}$	607	
$\eta\rho$	seen	†	
$\pi^+\pi^+\pi^-\pi^0$	< 50 %	84%	535
$K^*(892)^\pm K^\mp$	seen	†	
$(K\bar{K})^\pm\pi^0$	< 8 %	90%	248
$K_S^0 K_L^0 \pi^\pm$	< 6 %	90%	235
$K_S^0 K_S^0 \pi^\pm$	< 2 %	90%	235
$\phi\pi$	< 1.5 %	84%	147

NODE=M011215;DESIG=1;OUR EST;  
 → UNCHECKED ←  
 DESIG=9  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=74  
 DESIG=71;OUR EST;→ UNCHECKED ←  
 DESIG=73;OUR EST;→ UNCHECKED ←  
 DESIG=72;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←

**a<sub>1</sub>(1260) [k]**

$$I^G(J^{PC}) = 1^-(1^{++})$$

Mass  $m = 1230 \pm 40$  MeV [l]  
 Full width  $\Gamma = 250$  to 600 MeV

<b>a<sub>1</sub>(1260) DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$(\rho\pi)_S$ -wave	seen	353
$(\rho\pi)_D$ -wave	seen	353
$(\rho(1450)\pi)_S$ -wave	seen	†
$(\rho(1450)\pi)_D$ -wave	seen	†
$\sigma\pi$	seen	—
$f_0(980)\pi$	not seen	179
$f_0(1370)\pi$	seen	†
$f_2(1270)\pi$	seen	†
$K\bar{K}^*(892) + \text{c.c.}$	seen	†
$\pi\gamma$	seen	608

NODE=M010

NODE=M010M;DTYPE=M;OUR EST;  
 → UNCHECKED ←  
 NODE=M010W;DTYPE=G;OUR EST;  
 → UNCHECKED ←

**f<sub>2</sub>(1270)**

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass  $m = 1275.1 \pm 1.2$  MeV (S = 1.1)  
 Full width  $\Gamma = 185.1^{+2.9}_{-2.4}$  MeV (S = 1.5)

<b>f<sub>2</sub>(1270) DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$\pi\pi$	$(84.8^{+2.4}_{-1.2})\%$	S=1.2	623
$\pi^+\pi^-2\pi^0$	$(7.1^{+1.4}_{-2.7})\%$	S=1.3	562
$K\bar{K}$	$(4.6 \pm 0.4)\%$	S=2.8	403
$2\pi^+2\pi^-$	$(2.8 \pm 0.4)\%$	S=1.2	559
$\eta\eta$	$(4.0 \pm 0.8) \times 10^{-3}$	S=2.1	326
$4\pi^0$	$(3.0 \pm 1.0) \times 10^{-3}$		564
$\gamma\gamma$	$(1.64 \pm 0.19) \times 10^{-5}$	S=1.9	638
$\eta\pi\pi$	< 8 $\times 10^{-3}$	CL=95%	477
$K^0 K^- \pi^+ + \text{c.c.}$	< 3.4 $\times 10^{-3}$	CL=95%	293
$e^+e^-$	< 6 $\times 10^{-10}$	CL=90%	638

NODE=M010215;DESIG=7;OUR EST;  
 → UNCHECKED ←  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=10;OUR EST;→ UNCHECKED ←  
 DESIG=16;OUR EST;→ UNCHECKED ←  
 DESIG=11;OUR EST;→ UNCHECKED ←  
 DESIG=12;OUR EST;→ UNCHECKED ←  
 DESIG=13;OUR EST;→ UNCHECKED ←  
 DESIG=14;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←

NODE=M005

NODE=M005M;DTYPE=M  
 NODE=M005W;DTYPE=G

**f<sub>1</sub>(1285)**

$$I^G(J^{PC}) = 0^+(1^{++})$$

Mass  $m = 1281.9 \pm 0.5$  MeV (S = 1.8)  
 Full width  $\Gamma = 24.2 \pm 1.1$  MeV (S = 1.3)

NODE=M005215;DESIG=1  
 DESIG=3  
 DESIG=4  
 DESIG=2  
 DESIG=7  
 DESIG=9  
 DESIG=8  
 DESIG=6  
 DESIG=5  
 DESIG=10

NODE=M008

NODE=M008M;DTYPE=M  
 NODE=M008W;DTYPE=G

<b>f<sub>1</sub>(1285) DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)	
$4\pi$	$(33.1 \pm 2.1) \%$	S=1.3	568	NODE=M008215;DESIG=21
$\pi^0 \pi^0 \pi^+ \pi^-$	$(22.0 \pm 1.4) \%$	S=1.3	566	DESIG=22
$2\pi^+ 2\pi^-$	$(11.0 \pm 0.7) \%$	S=1.3	563	DESIG=20
$\rho^0 \pi^+ \pi^-$	$(11.0 \pm 0.7) \%$	S=1.3	336	DESIG=191
$\rho^0 \rho^0$	seen		†	DESIG=23;OUR EST; $\rightarrow$ UNCHECKED $\leftarrow$
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568	DESIG=7
$\eta \pi^+ \pi^-$	$(35 \pm 15) \%$		479	DESIG=198
$\eta \pi \pi$	$(52.4 \pm 1.9) \%$	S=1.2	482	DESIG=3
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\bar{K}$ ]	$(36 \pm 7) \%$		238	DESIG=4
$\eta \pi \pi$ [excluding $a_0(980)\pi$ ]	$(16 \pm 7) \%$		482	DESIG=5
$K\bar{K}\pi$	$(9.0 \pm 0.4) \%$	S=1.1	308	DESIG=1
$K\bar{K}^*(892)$	not seen		†	DESIG=6
$\pi^+ \pi^- \pi^0$	$(3.0 \pm 0.9) \times 10^{-3}$		603	DESIG=197
$\rho^\pm \pi^\mp$	$< 3.1 \times 10^{-3}$	CL=95%	390	DESIG=199
$\gamma \rho^0$	$(5.5 \pm 1.3) \%$	S=2.8	407	DESIG=13
$\phi \gamma$	$(7.4 \pm 2.6) \times 10^{-4}$		236	DESIG=10

 **$\eta(1295)$** 

$$I^G(J^{PC}) = 0^+(0 - +)$$

Mass  $m = 1294 \pm 4$  MeV (S = 1.6)Full width  $\Gamma = 55 \pm 5$  MeV

NODE=M037

NODE=M037M;DTYPE=M

NODE=M037W;DTYPE=G

 **$\eta(1295)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\eta \pi^+ \pi^-$	seen	487
$a_0(980)\pi$	seen	248
$\eta \pi^0 \pi^0$	seen	490
$\eta(\pi\pi)_S$ -wave	seen	—

NODE=M037215;DESIG=2;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=1;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=4;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=5;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$  **$\pi(1300)$** 

$$I^G(J^{PC}) = 1^-(0 - +)$$

Mass  $m = 1300 \pm 100$  MeV [1]Full width  $\Gamma = 200$  to 600 MeV

NODE=M058

NODE=M058M;DTYPE=M;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$   
NODE=M058W;DTYPE=G;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$  **$\pi(1300)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\rho \pi$	seen	404
$\pi(\pi\pi)_S$ -wave	seen	—

NODE=M058215;DESIG=1;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=3;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$  **$a_2(1320)$** 

$$I^G(J^{PC}) = 1^-(2 + +)$$

Mass  $m = 1318.3^{+0.5}_{-0.6}$  MeV (S = 1.2)Full width  $\Gamma = 107 \pm 5$  MeV [1]

NODE=M012

NODE=M012M0;DTYPE=M

NODE=M012W0;DTYPE=G;OUR EST;  
 $\rightarrow$  UNCHECKED  $\leftarrow$

<b><math>a_2(1320)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$3\pi$	(70.1 $\pm$ 2.7) %	S=1.2	624
$\eta\pi$	(14.5 $\pm$ 1.2) %		535
$\omega\pi\pi$	(10.6 $\pm$ 3.2) %	S=1.3	366
$K\bar{K}$	( 4.9 $\pm$ 0.8 ) %		437
$\eta'(958)\pi$	( 5.3 $\pm$ 0.9 ) $\times$ 10 <sup>-3</sup>		288
$\pi^\pm\gamma$	( 2.68 $\pm$ 0.31 ) $\times$ 10 <sup>-3</sup>		652
$\gamma\gamma$	( 9.4 $\pm$ 0.7 ) $\times$ 10 <sup>-6</sup>		659
$e^+e^-$	< 5 $\times$ 10 <sup>-9</sup>	CL=90%	659

NODE=M012215;DESIG=1  
 DESIG=3  
 DESIG=4  
 DESIG=2  
 DESIG=8  
 DESIG=7  
 DESIG=9  
 DESIG=10

 **$f_0(1370)$  [l]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 1200$  to 1500 MeV  
 Full width  $\Gamma = 200$  to 500 MeV

<b><math>f_0(1370)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi\pi$	seen	672
$4\pi$	seen	617
$4\pi^0$	seen	617
$2\pi^+2\pi^-$	seen	612
$\pi^+\pi^-2\pi^0$	seen	615
$\rho\rho$	dominant	†
$2(\pi\pi)_S$ -wave	seen	—
$\pi(1300)\pi$	seen	†
$a_1(1260)\pi$	seen	35
$\eta\eta$	seen	411
$K\bar{K}$	seen	475
$K\bar{K}n\pi$	not seen	†
$6\pi$	not seen	508
$\omega\omega$	not seen	†
$\gamma\gamma$	seen	685
$e^+e^-$	not seen	685

NODE=M147

NODE=M147M;DTYPE=M;OUR EST;  
 → UNCHECKED ←  
 NODE=M147W;DTYPE=G;OUR EST;  
 → UNCHECKED ←

 **$\pi_1(1400)$  [n]**

$$I^G(J^{PC}) = 1^-(1^{--})$$

Mass  $m = 1354 \pm 25$  MeV (S = 1.8)  
 Full width  $\Gamma = 330 \pm 35$  MeV

<b><math>\pi_1(1400)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\eta\pi^0$	seen	557
$\eta\pi^-$	seen	556

NODE=M111

NODE=M111M;DTYPE=M  
 NODE=M111W;DTYPE=G

 **$\eta(1405)$  [o]**

$$I^G(J^{PC}) = 0^+(0^{-+})$$

Mass  $m = 1408.8 \pm 1.8$  MeV [l] (S = 2.1)  
 Full width  $\Gamma = 51.0 \pm 2.9$  MeV [l] (S = 1.8)

NODE=M111215;DESIG=1;OUR EST;  
 → UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←

NODE=M027

NODE=M027MX;DTYPE=M  
 NODE=M027WX;DTYPE=G

<b><math>\eta(1405)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$K\bar{K}\pi$	seen		424
$\eta\pi\pi$	seen		562
$a_0(980)\pi$	seen		345
$\eta(\pi\pi)S\text{-wave}$	seen		—
$f_0(980)\eta$	seen		†
$4\pi$	seen		639
$\rho\rho$	<58 %	99.85%	†
$\rho^0\gamma$	seen		491
$K^*(892)K$	seen		123

 **$f_1(1420)$  [p]**

$$I^G(J^{PC}) = 0^+(1^{++})$$

Mass  $m = 1426.4 \pm 0.9$  MeV (S = 1.1)Full width  $\Gamma = 54.9 \pm 2.6$  MeV

<b><math>f_1(1420)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}\pi$	dominant	438
$K\bar{K}^*(892)+\text{c.c.}$	dominant	163
$\eta\pi\pi$	possibly seen	573
$\phi\gamma$	seen	349

 **$\omega(1420)$  [q]**

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass  $m$  (1400–1450) MeVFull width  $\Gamma$  (180–250) MeV

<b><math>\omega(1420)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\rho\pi$	dominant	486
$\omega\pi\pi$	seen	444
$b_1(1235)\pi$	seen	125
$e^+e^-$	seen	710

 **$a_0(1450)$  [l]**

$$I^G(J^{PC}) = 1^-(0^{++})$$

Mass  $m = 1474 \pm 19$  MeVFull width  $\Gamma = 265 \pm 13$  MeV

<b><math>a_0(1450)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi\eta$	seen	627
$\pi\eta'(958)$	seen	410
$K\bar{K}$	seen	547
$\omega\pi\pi$	seen	484
$a_0(980)\pi\pi$	seen	342
$\gamma\gamma$	seen	737

 **$\rho(1450)$  [r]**

$$I^G(J^{PC}) = 1^+(1^{--})$$

Mass  $m = 1465 \pm 25$  MeV [l]Full width  $\Gamma = 400 \pm 60$  MeV [l]

NODE=M027215;DESIG=2;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 DESIG=5;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=4;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=9;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=10;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=6;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=12  
 DESIG=8;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=11;OUR EST; $\rightarrow$  UNCHECKED ←

NODE=M006

NODE=M006M2;DTYPE=M  
 NODE=M006W;DTYPE=G

NODE=M006215;DESIG=2;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 DESIG=1;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=5;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=9;OUR EST; $\rightarrow$  UNCHECKED ←

NODE=M125

NODE=M125M;DTYPE=M;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 NODE=M125W;DTYPE=G;OUR EST;  
 $\rightarrow$  UNCHECKED ←

NODE=M125215;DESIG=1;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 DESIG=4;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=5;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=3;OUR EST; $\rightarrow$  UNCHECKED ←

NODE=M149

NODE=M149M;DTYPE=M  
 NODE=M149W;DTYPE=G

NODE=M149215;DESIG=1;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 DESIG=2;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=3;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=4;OUR EST; $\rightarrow$  UNCHECKED ←  
 DESIG=5  
 DESIG=6

NODE=M105

NODE=M105M0;DTYPE=M;OUR EST;  
 $\rightarrow$  UNCHECKED;  $\leftarrow$  UNCHECKED ←  
 NODE=M105W0;DTYPE=G;OUR EST;  
 $\rightarrow$  UNCHECKED ←

<b><math>\rho(1450)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi\pi$	seen	720
$4\pi$	seen	669
$e^+e^-$	seen	732
$\eta\rho$	possibly seen	311
$a_2(1320)\pi$	not seen	54
$K\bar{K}$	not seen	541
$K\bar{K}^*(892) + \text{c.c.}$	possibly seen	229
$\eta\gamma$	possibly seen	630
$f_0(500)\gamma$	not seen	—
$f_0(980)\gamma$	not seen	398
$f_0(1370)\gamma$	not seen	92
$f_2(1270)\gamma$	not seen	178

 **$\eta(1475)$**  [o]

$$I^G(J^{PC}) = 0^+(0 - +)$$

Mass  $m = 1476 \pm 4$  MeV (S = 1.3)  
 Full width  $\Gamma = 85 \pm 9$  MeV (S = 1.5)

<b><math>\eta(1475)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}\pi$	dominant	477
$K\bar{K}^*(892) + \text{c.c.}$	seen	245
$a_0(980)\pi$	seen	396
$\gamma\gamma$	seen	738

 **$f_0(1500)$**  [n]

$$I^G(J^{PC}) = 0^+(0 + +)$$

Mass  $m = 1505 \pm 6$  MeV (S = 1.3)  
 Full width  $\Gamma = 109 \pm 7$  MeV

<b><math>f_0(1500)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor	$p$ (MeV/c)
$\pi\pi$	(34.9 ± 2.3) %	1.2	741
$\pi^+\pi^-$	seen	740	
$2\pi^0$	seen	741	
$4\pi$	(49.5 ± 3.3) %	1.2	691
$4\pi^0$	seen	691	
$2\pi^+2\pi^-$	seen	687	
$2(\pi\pi)_{S\text{-wave}}$	seen	—	
$\rho\rho$	seen	†	
$\pi(1300)\pi$	seen	144	
$a_1(1260)\pi$	seen	218	
$\eta\eta$	( 5.1 ± 0.9 ) %	1.4	516
$\eta\eta'(958)$	( 1.9 ± 0.8 ) %	1.7	†
$K\bar{K}$	( 8.6 ± 1.0 ) %	1.1	568
$\gamma\gamma$	not seen	753	

 **$f'_2(1525)$** 

$$I^G(J^{PC}) = 0^+(2 + +)$$

Mass  $m = 1525 \pm 5$  MeV [l]  
 Full width  $\Gamma = 73^{+6}_{-5}$  MeV [l]

NODE=M105215;DESIG=1;OUR EST;  
 → UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EVAL;→ UNCHECKED ←  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EVAL;→ UNCHECKED ←  
 DESIG=15;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=16;OUR EST;→ UNCHECKED ←  
 DESIG=17;OUR EST;→ UNCHECKED ←  
 DESIG=18;OUR EST;→ UNCHECKED ←  
 DESIG=19;OUR EST;→ UNCHECKED ←

NODE=M175

NODE=M175M5;DTYPE=M  
 NODE=M175W5;DTYPE=G

NODE=M175215;DESIG=2;OUR EST;  
 → UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EST;→ UNCHECKED ←

NODE=M152

NODE=M152M;DTYPE=M  
 NODE=M152W;DTYPE=G

NODE=M152215;DESIG=8  
 DESIG=9  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=7  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=11;OUR EST;→ UNCHECKED ←  
 DESIG=12;OUR EST;→ UNCHECKED ←  
 DESIG=13;OUR EST;→ UNCHECKED ←  
 DESIG=14;OUR EST;→ UNCHECKED ←  
 DESIG=1  
 DESIG=2  
 DESIG=4  
 DESIG=10;OUR EST;→ UNCHECKED ←

NODE=M013

NODE=M013MX;DTYPE=M;OUR EST;  
 → UNCHECKED ←  
 NODE=M013WX;DTYPE=G

**$f_2'(1525)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$K\bar{K}$	(88.7 $\pm$ 2.2) %	581
$\eta\eta$	(10.4 $\pm$ 2.2) %	530
$\pi\pi$	( 8.2 $\pm$ 1.5 ) $\times$ 10 $^{-3}$	750
$\gamma\gamma$	( 1.11 $\pm$ 0.14) $\times$ 10 $^{-6}$	763

NODE=M013215;DESIG=2  
DESIG=4  
DESIG=1  
DESIG=8

 **$\pi_1(1600)$  [n]** $I^G(J^{PC}) = 1^-(1^-+)$ Mass  $m = 1662^{+8}_{-9}$  MeVFull width  $\Gamma = 241 \pm 40$  MeV (S = 1.4) **$\pi_1(1600)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\pi\pi\pi$	not seen	803
$\rho^0\pi^-$	not seen	641
$f_2(1270)\pi^-$	not seen	318
$b_1(1235)\pi$	seen	357
$\eta'(958)\pi^-$	seen	543
$f_1(1285)\pi$	seen	314

NODE=M164

NODE=M164M;DTYPE=M  
NODE=M164W;DTYPE=G

 **$\eta_2(1645)$**  $I^G(J^{PC}) = 0^+(2^-+)$ Mass  $m = 1617 \pm 5$  MeVFull width  $\Gamma = 181 \pm 11$  MeV **$\eta_2(1645)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$a_2(1320)\pi$	seen	242
$K\bar{K}\pi$	seen	580
$K^*\bar{K}$	seen	404
$\eta\pi^+\pi^-$	seen	685
$a_0(980)\pi$	seen	499
$f_2(1270)\eta$	not seen	†

NODE=M154

NODE=M154M;DTYPE=M  
NODE=M154W;DTYPE=G

 **$\omega(1650)$  [s]** $I^G(J^{PC}) = 0^-(1^- -)$ Mass  $m = 1670 \pm 30$  MeVFull width  $\Gamma = 315 \pm 35$  MeV **$\omega(1650)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\rho\pi$	seen	647
$\omega\pi\pi$	seen	617
$\omega\eta$	seen	500
$e^+e^-$	seen	835

NODE=M126

NODE=M126M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=M126W;DTYPE=G;OUR EST;  
→ UNCHECKED ←

 **$\omega_3(1670)$**  $I^G(J^{PC}) = 0^-(3^- -)$ Mass  $m = 1667 \pm 4$  MeVFull width  $\Gamma = 168 \pm 10$  MeV [l]

NODE=M126215;DESIG=1;OUR EST;  
→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←

NODE=M045

NODE=M045M;DTYPE=M  
NODE=M045W;DTYPE=G

**$\omega_3(1670)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\rho\pi$	seen	645
$\omega\pi\pi$	seen	615
$b_1(1235)\pi$	possibly seen	361

 **$\pi_2(1670)$**  $I^G(J^{PC}) = 1^-(2^-+)$ Mass  $m = 1672.2 \pm 3.0$  MeV [1] ( $S = 1.4$ )  
Full width  $\Gamma = 260 \pm 9$  MeV [1] ( $S = 1.2$ ) **$\pi_2(1670)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ )

Confidence level

 $p$ 

(MeV/c)

$3\pi$	(95.8 $\pm$ 1.4) %	809
$f_2(1270)\pi$	(56.3 $\pm$ 3.2) %	329
$\rho\pi$	(31 $\pm$ 4) %	648
$\sigma\pi$	(10.9 $\pm$ 3.4) %	—
$(\pi\pi)_S$ -wave	( 8.7 $\pm$ 3.4) %	—
$K\bar{K}^*(892)+$ c.c.	( 4.2 $\pm$ 1.4) %	455
$\omega\rho$	( 2.7 $\pm$ 1.1) %	304
$\gamma\gamma$	< 2.8 $\times 10^{-7}$	90%
$\rho(1450)\pi$	< 3.6 $\times 10^{-3}$	97.7%
$b_1(1235)\pi$	< 1.9 $\times 10^{-3}$	97.7%
$f_1(1285)\pi$	possibly seen	323
$a_2(1320)\pi$	not seen	292

 **$\phi(1680)$**  $I^G(J^{PC}) = 0^-(1^{--})$ Mass  $m = 1680 \pm 20$  MeV [1]  
Full width  $\Gamma = 150 \pm 50$  MeV [1] **$\phi(1680)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$K\bar{K}^*(892)+$ c.c.	dominant	462
$K_S^0 K\pi$	seen	621
$K\bar{K}$	seen	680
$e^+e^-$	seen	840
$\omega\pi\pi$	not seen	623
$K^+K^-\pi^+\pi^-$	seen	544

 **$\rho_3(1690)$**  $I^G(J^{PC}) = 1^+(3^{--})$ Mass  $m = 1688.8 \pm 2.1$  MeV [1]  
Full width  $\Gamma = 161 \pm 10$  MeV [1] ( $S = 1.5$ ) **$\rho_3(1690)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ )

Scale factor

 $p$ 

(MeV/c)

$4\pi$	(71.1 $\pm$ 1.9) %	790
$\pi^\pm\pi^+\pi^-\pi^0$	(67 $\pm$ 22) %	787
$\omega\pi$	(16 $\pm$ 6) %	655
$\pi\pi$	(23.6 $\pm$ 1.3) %	834
$K\bar{K}\pi$	( 3.8 $\pm$ 1.2) %	629
$K\bar{K}$	( 1.58 $\pm$ 0.26) %	685
$\eta\pi^+\pi^-$	seen	727
$\rho(770)\eta$	seen	520
$\pi\pi\rho$	seen	633
Excluding $2\rho$ and $a_2(1320)\pi$ .		
$a_2(1320)\pi$	seen	307
$\rho\rho$	seen	335

 **$\rho(1700)$  [1]** $I^G(J^{PC}) = 1^+(1^{--})$ Mass  $m = 1720 \pm 20$  MeV [1] ( $\eta\rho^0$  and  $\pi^+\pi^-$  modes)  
Full width  $\Gamma = 250 \pm 100$  MeV [1] ( $\eta\rho^0$  and  $\pi^+\pi^-$  modes)NODE=M045215;DESIG=1;OUR EST;  
DESIG=UNCHECKED;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←

NODE=M034

NODE=M034M;DTYPE=M

NODE=M034W;DTYPE=G

NODE=M034215;DESIG=20

DESIG=8

DESIG=2

DESIG=13

DESIG=11

DESIG=5

DESIG=14

DESIG=12

DESIG=15

DESIG=16

DESIG=25

DESIG=26

NODE=M067

NODE=M067M1;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=M067W1;DTYPE=G;OUR EST;  
→ UNCHECKED ←NODE=M067215;DESIG=4;OUR EST;  
DESIG=UNCHECKED;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=12;OUR EVAL;→ UNCHECKED ←

NODE=M015

NODE=M015M;DTYPE=M

NODE=M015W;DTYPE=G

NODE=M015215;DESIG=2

DESIG=11

DESIG=7

DESIG=1

DESIG=3

DESIG=4

DESIG=13

DESIG=14;OUR EST;→ UNCHECKED ←  
DESIG=5;OUR EST;→ UNCHECKED ←DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EST;→ UNCHECKED ←

NODE=M065

NODE=M065M0;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=M065W0;DTYPE=G;OUR EST;  
→ UNCHECKED ←

**$f_0(1700)$  DECAY MODES**

	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$2(\pi^+ \pi^-)$	large	803
$\rho \pi \pi$	dominant	653
$\rho^0 \pi^+ \pi^-$	large	651
$\rho^\pm \pi^\mp \pi^0$	large	652
$a_1(1260) \pi$	seen	404
$h_1(1170) \pi$	seen	447
$\pi(1300) \pi$	seen	349
$\rho \rho$	seen	372
$\pi^+ \pi^-$	seen	849
$\pi \pi$	seen	849
$K \bar{K}^*(892) + \text{c.c.}$	seen	496
$\eta \rho$	seen	545
$a_2(1320) \pi$	not seen	334
$K \bar{K}$	seen	704
$e^+ e^-$	seen	860
$\pi^0 \omega$	seen	674

 **$f_0(1710)$  [t]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 1720 \pm 6$  MeV (S = 1.6)  
 Full width  $\Gamma = 135 \pm 8$  MeV (S = 1.1)

 **$f_0(1710)$  DECAY MODES**

	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K \bar{K}$	seen	704
$\eta \eta$	seen	663
$\pi \pi$	seen	849
$\omega \omega$	seen	357

 **$\pi(1800)$** 

$$I^G(J^{PC}) = 1^-(0^{-+})$$

Mass  $m = 1812 \pm 12$  MeV (S = 2.3)  
 Full width  $\Gamma = 208 \pm 12$  MeV

 **$\pi(1800)$  DECAY MODES**

	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi^+ \pi^- \pi^-$	seen	879
$f_0(500) \pi^-$	seen	-
$f_0(980) \pi^-$	seen	625
$f_0(1370) \pi^-$	seen	368
$f_0(1500) \pi^-$	not seen	250
$\rho \pi^-$	not seen	732
$\eta \eta \pi^-$	seen	661
$a_0(980) \eta$	seen	473
$a_2(1320) \eta$	not seen	†
$f_2(1270) \pi$	not seen	442
$f_0(1370) \pi^-$	not seen	368
$f_0(1500) \pi^-$	seen	250
$\eta \eta'(958) \pi^-$	seen	375
$K_0^*(1430) K^-$	seen	†
$K^*(892) K^-$	not seen	570

 **$\phi_3(1850)$** 

$$I^G(J^{PC}) = 0^-(3^{--})$$

Mass  $m = 1854 \pm 7$  MeV  
 Full width  $\Gamma = 87^{+28}_{-23}$  MeV (S = 1.2)

NODE=M065215;DESIG=2;OUR EST;  
 DESIG=12;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=15;OUR EST;→ UNCHECKED ←  
 DESIG=16;OUR EST;→ UNCHECKED ←  
 DESIG=17;OUR EST;→ UNCHECKED ←  
 DESIG=18;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=13;OUR EST;→ UNCHECKED ←  
 DESIG=10;OUR EST;→ UNCHECKED ←  
 DESIG=11;OUR EST;→ UNCHECKED ←  
 DESIG=14;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←

NODE=M068

NODE=M068M;DTYPE=M  
 NODE=M068W;DTYPE=G

NODE=M068215;DESIG=2;OUR EST;  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=4

NODE=M075

NODE=M075M;DTYPE=M  
 NODE=M075W;DTYPE=G

NODE=M075215;DESIG=10;OUR EST;  
 DESIG=11;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=1  
 DESIG=12  
 DESIG=2  
 DESIG=7;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=13  
 DESIG=14  
 DESIG=15  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=4  
 DESIG=9

NODE=M054

NODE=M054M;DTYPE=M  
 NODE=M054W;DTYPE=G

**$\phi_3(1850)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$K\bar{K}$	seen	785
$K\bar{K}^*(892) + \text{c.c.}$	seen	602

 **$\pi_2(1880)$** 

$I^G(J^{PC}) = 1^-(2^-+)$

Mass  $m = 1895 \pm 16$  MeVFull width  $\Gamma = 235 \pm 34$  MeV **$f_2(1950)$** 

$I^G(J^{PC}) = 0^+(2^{++})$

Mass  $m = 1944 \pm 12$  MeV (S = 1.5)Full width  $\Gamma = 472 \pm 18$  MeV **$f_2(1950)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$K^*(892)\bar{K}^*(892)$	seen	387
$\pi^+\pi^-$	seen	962
$\pi^0\pi^0$	seen	963
$4\pi$	seen	925
$\eta\eta$	seen	803
$K\bar{K}$	seen	837
$\gamma\gamma$	seen	972
$p\bar{p}$	seen	254

 **$f_2(2010)$** 

$I^G(J^{PC}) = 0^+(2^{++})$

Mass  $m = 2011^{+60}_{-80}$  MeVFull width  $\Gamma = 202 \pm 60$  MeV **$f_2(2010)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$\phi\phi$	seen	†
$K\bar{K}$	seen	876

 **$a_4(2040)$** 

$I^G(J^{PC}) = 1^-(4^{++})$

Mass  $m = 1996^{+10}_{-9}$  MeV (S = 1.1)Full width  $\Gamma = 255^{+28}_{-24}$  MeV (S = 1.3) **$a_4(2040)$  DECAY MODES**Fraction ( $\Gamma_i/\Gamma$ ) $p$  (MeV/c)

$K\bar{K}$	seen	868
$\pi^+\pi^-\pi^0$	seen	974
$\rho\pi$	seen	841
$f_2(1270)\pi$	seen	580
$\omega\pi^-\pi^0$	seen	819
$\omega\rho$	seen	624
$\eta\pi^0$	seen	918
$\eta'(958)\pi$	seen	761

 **$f_4(2050)$** 

$I^G(J^{PC}) = 0^+(4^{++})$

Mass  $m = 2018 \pm 11$  MeV (S = 2.1)Full width  $\Gamma = 237 \pm 18$  MeV (S = 1.9)NODE=M054215;DESIG=1;OUR EST;  
→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←

NODE=M185

NODE=M185M;DTYPE=M

NODE=M185W;DTYPE=G

NODE=M135

NODE=M135M;DTYPE=M

NODE=M135W;DTYPE=G

NODE=M135215;DESIG=1

DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=10;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EST;→ UNCHECKED ←  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=9;OUR EST;→ UNCHECKED ←  
DESIG=12

NODE=M106

NODE=M106M;DTYPE=M

NODE=M106W;DTYPE=G

NODE=M106215;DESIG=1;OUR EST;  
→ UNCHECKED ←  
DESIG=2

NODE=M017

NODE=M017M;DTYPE=M

NODE=M017W;DTYPE=G

NODE=M017215;DESIG=1

DESIG=2  
DESIG=5;OUR EST;→ UNCHECKED ←  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EST;→ UNCHECKED ←  
DESIG=8  
DESIG=3  
DESIG=4;OUR EST;→ UNCHECKED ←

NODE=M016

NODE=M016M;DTYPE=M

NODE=M016W;DTYPE=G

<b><math>f_4(2050)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)	
$\omega\omega$	seen	637	NODE=M016215;DESIG=6
$\pi\pi$	( $17.0 \pm 1.5$ ) %	1000	DESIG=1
$K\bar{K}$	( $6.8^{+3.4}_{-1.8} \times 10^{-3}$ )	880	DESIG=2
$\eta\eta$	( $2.1 \pm 0.8 \times 10^{-3}$ )	848	DESIG=3
$4\pi^0$	< 1.2 %	964	DESIG=5
$a_2(1320)\pi$	seen	567	DESIG=7

 **$\phi(2170)$** 

$I^G(J^{PC}) = 0^-(1^{--})$

Mass  $m = 2175 \pm 15$  MeV (S = 1.6)Full width  $\Gamma = 61 \pm 18$  MeV

<b><math>\phi(2170)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)	
$e^+e^-$	seen	1087	NODE=M103215;DESIG=1;OUR EVAL;
$\phi f_0(980)$	seen	416	DESIG=2;OUR EVAL; $\rightarrow$ UNCHECKED $\leftarrow$ DESIG=6
$K^+K^-f_0(980) \rightarrow$	seen	-	
$K^+K^-\pi^+\pi^-$			
$K^+K^-f_0(980) \rightarrow K^+K^-\pi^0\pi^0$	seen	-	DESIG=7
$K^{*0}K^\pm\pi^\mp$	not seen	770	DESIG=8
$K^*(892)^0\bar{K}^*(892)^0$	not seen	622	DESIG=10

 **$f_2(2300)$** 

$I^G(J^{PC}) = 0^+(2^{++})$

Mass  $m = 2297 \pm 28$  MeVFull width  $\Gamma = 149 \pm 40$  MeV

<b><math>f_2(2300)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)	
$\phi\phi$	seen	529	NODE=M107215;DESIG=1;OUR EST;
$K\bar{K}$	seen	1037	DESIG=2;OUR EST; $\rightarrow$ UNCHECKED $\leftarrow$ DESIG=3;OUR EST; $\rightarrow$ UNCHECKED $\leftarrow$
$\gamma\gamma$	seen	1149	

 **$f_2(2340)$** 

$I^G(J^{PC}) = 0^+(2^{++})$

Mass  $m = 2339 \pm 60$  MeVFull width  $\Gamma = 319^{+80}_{-70}$  MeV

<b><math>f_2(2340)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)	
$\phi\phi$	seen	573	NODE=M108215;DESIG=1;OUR EST;
$\eta\eta$	seen	1033	DESIG=2;OUR EST; $\rightarrow$ UNCHECKED $\leftarrow$

## NOTES

- [a] See the “Note on  $\pi^\pm \rightarrow \ell^\pm \nu_\gamma$  and  $K^\pm \rightarrow \ell^\pm \nu_\gamma$  Form Factors” in the  $\pi^\pm$  Particle Listings for definitions and details. LINKAGE=SWK
- [b] Measurements of  $\Gamma(e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$  always include decays with  $\gamma$ 's, and measurements of  $\Gamma(e^+ \nu_e \gamma)$  and  $\Gamma(\mu^+ \nu_\mu \gamma)$  never include low-energy  $\gamma$ 's. Therefore, since no clean separation is possible, we consider the modes with  $\gamma$ 's to be subreactions of the modes without them, and let  $[\Gamma(e^+ \nu_e) + \Gamma(\mu^+ \nu_\mu)]/\Gamma_{\text{total}} = 100\%$ . LINKAGE=LX2
- [c] See the  $\pi^\pm$  Particle Listings for the energy limits used in this measurement; low-energy  $\gamma$ 's are not included. LINKAGE=LX1
- [d] Derived from an analysis of neutrino-oscillation experiments. LINKAGE=CL
- [e] Astrophysical and cosmological arguments give limits of order  $10^{-13}$ ; see the  $\pi^0$  Particle Listings. LINKAGE=S9
- [f]  $C$  parity forbids this to occur as a single-photon process. LINKAGE=CS
- [g] See the “Note on scalar mesons” in the  $f_0(500)$  Particle Listings . The interpretation of this entry as a particle is controversial. LINKAGE=NS2
- [h] See the “Note on  $\rho(770)$ ” in the  $\rho(770)$  Particle Listings . LINKAGE=NRH
- [i] The  $\omega\rho$  interference is then due to  $\omega\rho$  mixing only, and is expected to be small. If  $e\mu$  universality holds,  $\Gamma(\rho^0 \rightarrow \mu^+ \mu^-) = \Gamma(\rho^0 \rightarrow e^+ e^-) \times 0.99785$ . LINKAGE=MD2
- [j] See the “Note on scalar mesons” in the  $f_0(500)$  Particle Listings . LINKAGE=NSM
- [k] See the “Note on  $a_1(1260)$ ” in the  $a_1(1260)$  Particle Listings in PDG 06, Journal of Physics, G **33** 1 (2006). LINKAGE=NA1
- [l] This is only an educated guess; the error given is larger than the error on the average of the published values. See the Particle Listings for details. LINKAGE=MS
- [n] See the “Note on non- $q\bar{q}$  mesons” in the Particle Listings in PDG 06, Journal of Physics, G **33** 1 (2006). LINKAGE=NQQ
- [o] See the “Note on the  $\eta(1405)$ ” in the  $\eta(1405)$  Particle Listings. LINKAGE=MG
- [p] See the “Note on the  $f_1(1420)$ ” in the  $\eta(1405)$  Particle Listings. LINKAGE=MDA
- [q] See also the  $\omega(1650)$  Particle Listings. LINKAGE=MDE
- [r] See the “Note on the  $\rho(1450)$  and the  $\rho(1700)$ ” in the  $\rho(1700)$  Particle Listings. LINKAGE=MDC
- [s] See also the  $\omega(1420)$  Particle Listings. LINKAGE=MDF
- [t] See the “Note on  $f_0(1710)$ ” in the  $f_0(1710)$  Particle Listings in 2004 edition of *Review of Particle Physics*. LINKAGE=NFJ